

# Research Paper Review

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Physical exercises in the treatment of adolescent scoliosis: An updated systematic review. Physiotherapy and Practice 2011; 27(1): 80-88

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## **ABSTRACT**

Two years ago we published an update of another of our previous systematic reviews about the effectiveness of physical exercises (PEs), and we found that the evidence on exercises for AIS was of level 1b. Now we have updated these results in the field of exercises for AIS with the final aim to find the strongest evidence as possible about PEs. Our goal was to verify if treatment with specific exercises for AIS has changed in these years. The study design was a systematic review. A bibliographic search with strict inclusion criteria (patients treated exclusively with exercises, outcome Cobb degrees, all study designs) has been performed on the main electronic databases. We found a new paper about active autocorrection (Negrini et al, 2008 b), a prospective controlled cohort observational study on patients never treated before so the number of manuscripts considered in the systematic review was 20. The highest quality study (RCT) compared 2 groups of 40 patients, showing an improvement of the curve in all treated patients after 6 months. All studies confirmed the efficacy of exercises in reducing the progression rate (mainly in early puberty) and/or improving the Cobb angles (around the end of growth). Exercises were also shown to be effective in reducing brace prescription. Appendices of the popular exercise protocols that have been used in the research studies that are examined are included with detailed description and illustrations. This study (like the previously published systematic reviews) showed that PEs can improve the Cobb angles of individuals with AIS and can improve strength, mobility, and balance. The level of evidence remains 1b according to the Oxford Centre for Evidence-based Medicine, as previously documented.

#### **ANALYSIS**

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#### **Background Information**

Adolescent idiopathic scoliosis (AIS) is a subject of tremendous debate in the medical and manual therapy communities. The most important subject therein, is whether to treat this condition conservatively or with typical medical and surgical means. The term 'conservative treatment' encompasses physical exercise, bracing, electrical stimulation, manipulation, physical therapy and orthotic inserts. Many researchers and clinicians who advocate the use of physical exercise to treat AIS appreciate the intervention's capability to positively influence one's spinal curvature, its ability to increase stability and neuromotor control of the spine, its ability to reduce postural collapse and improve breathing function (1). There is a growing clinical and research interest in using physical exercise for the purpose of treating AIS. It is thus the goal of this systematic review to understand the role of exercise in the treatment of AIS and to propose a method of increasing the effectiveness of exercise protocols.

#### PERTINENT RESULTS

Twenty studies were included in the literature review. Only one randomized control trial on this topic was found. The results of this study showed that over the course of 6 months of physical therapy treatment, there is the potential for Cobb angles of thoracic and lumbar curves to change significantly. However, angles changed significantly in both the control group (treated with electrical stimulation, traction, postural training) and the experimental group (treated the same as the control, only with the addition of specific asymmetric physical exercises for correction of scoliosis once a day), compared to baseline. However, the margin of improvement in the experimental group ( $-15^\circ$ ) was greater than that of the control group ( $-7^\circ$ ).

One of the most important concepts to grasp prior to developing programs for AIS and interpreting research about the topic is 'autoregulation.' Autocorrection is defined as the ability to reduce the spinal curvature via active realignment of the patient's spine in three dimensions. These exercises are performed as much as possible in three dimensions, in an effort to make the vertebral column move in the desired direction and then stay in the corrected position. These exercises entail activating the trunk muscles and limbs in such a way as to result in movement of the vertebral column in three planes of motion. In the frontal plane, the desired effect is to correct the lateral deviation. In the coronal plane, the physiological curves are promoted, while in the transverse plane, the rotational deformity is reduced. This is known to be the key technique in AIS physical therapy.

Of the studies which examined the use of rehabilitation with autoregulation, three utilized the Scroth program. The Scroth program consists of an intense inpatient physical therapy, which includes 5-6 hours of treatment per day, 6 days a week over the course of 4-6 weeks (this is a very intense program!). Subsequent to this, a home exercise program is implemented, using the same exercise program utilized in the inpatient phase, for only 30 minutes a day. The therapeutic exercises and physical therapy techniques used include elongation, realignment of trunk segments, positioning of the arms, corrective muscle tension, breathing exercises, mirror control, external stimuli (i.e. hand of the therapist) and proprioceptive assistance.

The evidence for the use of the Scroth program, as intensive as it is, is variable. One study found improvements in 44% of subjects and a worsening of curves in 3%. Another found that the condition of 25% of subjects worsened, while 18% improved. A third study utilized two subgroups matched for sex and age and compared them against a control group. The two experimental groups received 'scoliosis

intensive inpatient rehabilitation (SIR)', while the control group received no treatment. Both experimental groups' curves improved significantly (younger group: 53% improvement in Cobb degrees; older group 70% improvement in Cobb degrees) greater than the control group, who featured only a 29% change in their Cobb angles.

Some of the studies included in the review used a method called the Integrated Scoliosis Rehabilitation (ISR) program, which is known to be a multifaceted approach to management of AIS. This program typically involves the use of Physio-logic exercises<sup>®</sup>, 3D exercises made easy, spinal mobilization by a physiotherapist and pattern specific activities of daily living (ADLs), in addition to the Schroth method. Physio-logic exercises<sup>®</sup> are symmetric mobilizing exercises for the thoracic and lumbar spinal curvatures. Additionally, 3D exercises are said to improve postural correction in the sagittal and coronal planes.

The authors discuss one ISR study where the subjects assigned to the experimental group (treated with ISR) experienced a 1.2° change in their curves, while the control group, who were treated with a standard SIR program, experienced a smaller improvement of 0.8°. The authors therefore concluded that ISR may be helpful in reducing the lateral deviation of the scoliotic spine.

Since the Scroth program was designed as an inpatient program, other researchers sought to determine its efficacy in an outpatient setting. In this program, patients were to perform 2-4 hours of exercise a day over the course of 2-5 days a week. One study, found that outpatient adolescents who exercise 2 hours a day for 3 months could potentially improve their condition. Forty-four percent of the subjects included in the study improved their curvature, while 11.6% worsened. A second study utilizing an outpatient Scroth method (4hrs/day, 5 days/week for 6 weeks), observed that all 50 patients included in the study improved their Cobb degrees anywhere between 17.8-26.1°.

Some of the articles included in the review examined the DoboMed scoliosis program, which is a form of physiotherapy aimed to correct scoliotic deformities via active three-dimensional autocorrection. The vertebra belonging to the primary curve are mobilized toward their normal position in the transverse plane (rotation about the sagittal plane) of the trunk by using closed kinematic exercises, which are carried out on a symmetrically positioned pelvis and shoulder girdle. First, specific respiratory movements guide the de-rotation of the thoracic spine. Subsequently, active stabilization of the corrected position achieved is performed and engrained as a postural habit. The study included by the authors in this review (2) reported a 31-39% decrease in the Cobb angle!

Other outpatient physical therapy programs utilizing autocorrection of the spinal curve through a lateral shift of the trunk into the concavity of the curve were also examined. The lateral shift exercises are theorized to reduce the lateral tilt at the inferior end vertebra, while correcting the curve in the side shift position. One study compared side shift exercises with orthopedic bracing in 14 year old adolescents. Those subjects included into the side shift therapy group were asked to side shift as often as possible throughout a normal day over the course of 2.2 years. The patients assigned to the brace group, wore their braces for 3 years. The authors found no statistically significant difference between the two groups over the study period.

Another study examining lateral shifting exercises utilized a daily regimen of 10 second long muscular endurance exercises. The patients were required to perform lateral shift holds into the concavity and a separate exercise described as lifting the heel on the convex side of their curve while keeping their knee

and hip straight. Both of these exercises were executed in the standing position and were repeated at least 30 times daily over the course of 4.2 years. Fourteen percent of the subjects improved their curves moderately, while 22% of curves worsened.

A different exercise program called the Scientific Exercises Approach to Scoliosis (SEAS) was also investigated. It is an autoregulation program, based on the basic principles of a cognitive-behavioural approach. Exercises should be performed by the patient exclusively through the spinal deep paravertebral musculature in all three planes, with no external help. The patients pursue a precise and intrinsic control of movement without using superficial muscular contraction strategies that draw the spine into a passive alignment. One of the primary goals of this approach is intrinsic stability. Intrinsic stability is obtained by working on stabilizing muscles without producing movement of the spine about a large range of motion. Balance perturbations while standing are also used. The most recent study which investigated this method studied two groups of adolescents with spinal curvatures of approximately 30°, who were also at risk of needing orthopedic bracing. One group was treated with the SEAS program, while the other was treated with physical exercises that are not strictly applied to scoliotic patients. The primary outcomes in this study were the number of patients braced, Cobb angle measurements and the angle of trunk rotation. Only 6.1% of the patients in the SEAS program were braced over the course of the program, while 25% of the patients in the control group were braced, creating a statistically significant difference. Additionally, 23.5% of the individuals assigned to the SEAS group improved their Cobb angle, while only 11.1% in the control group improved.

Many of the articles and physical exercise programs discussed thus far have utilized autoregulation as a component of their rehabilitation programs. Other rehabilitation programs which do not utilize autoregulation also exist. Three articles exploring asymmetric exercises using the MedX Rotary Torso Machine for trunk rotation strength training were included in this review. One pilot study (3) which utilized this rehabilitation device assigned patients to 2 training sessions/week until symmetry of strength was observed bilaterally in each patient. Once subjects reached this level of fitness, therapy was reduced to once a week for 4 months. The patients improved by an average of 19°. Only one patient worsened.

#### **CLINICAL APPLICATION & CONCLUSIONS**

If correctly administered, physical exercises can prevent worsening of an AIS curve and can sometimes result in not having to brace a potentially worsening adolescent patient. Another theme demonstrated by this review is the need to adhere to scientifically based sources when implementing rehabilitation programs for AIS. Many older studies, which feature less sound methodology and interventions, suggest that physical exercise is entirely ineffective in the treatment of AIS. However, there are many studies with better methodology, which demonstrate that physical exercises can be efficacious. More research in this area is certainly warranted, particularly on outpatient programs that can easily be implemented in a normal practice environment.

EDITOR'S NOTE: What struck me about the summary of this research is that in any given study, using any given exercise approach or program, some subjects experienced a worsening of their curve. To me, this suggests that responses to exercise interventions may be a very individual factor. In other words, it is highly unlikely that there is a one-size-fits-all program for slowing the progression of, or correcting, scoliotic curvature. I also feel it is worth mentioning that for many patients, the cost and inconvenience of inpatient programs would be limiting. Future research should certainly focus on outpatient approaches. Lastly, readers should understand that overall, there is no gold standard treatment for scoliosis, and this statement includes manual therapy, bracing, and surgical approaches. Evidence-informed clinicians should individually assess each case, monitor for progression, address pain or dysfunction in a reasonable manner, and refer for a surgical/bracing consult depending on the patient's age and rate of progression.

# **STUDY METHODS**

The Medline, Embase, Cinahl, PEDro and Cochrane Library databases were searched. The inclusion criteria for selecting studies were as follows:

- Patients who have been diagnosed with AIS, confirmed with radiographs during adolescence (up to Risser's sign stage 5).
- Patients who were treated exclusively with physical exercise and no other intervention
- Included a control group
- Usage of the Cobb angle as the outcome measure
- Utilization of any study design

All included studies were divided according to their methodological quality, type of exercise intervention (inpatient or outpatient) and type of exercise used as treatment. The type of exercise used was subdivided into exercises with autocorrection (AC) or without autocorrection.

# **STUDY STRENGTHS / WEAKNESSES**

## Weaknesses

- Many of the exercise protocols were poorly described by the authors
- The inclusion criteria were too rigid. For instance, the authors only included articles that utilized the Cobb angle to measure scoliosis. While Cobb angle is the gold standard measurement for scoliotic curves, articles finding an appreciable change (independent of the actual number) of curves as a result of physical therapy using other methods of measurement should have been included.

# Strengths

• A variety of databases were searched for articles using search terms within their inclusion criteria.

# Additional References

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